AYK REGION
Norton Sound/Kotzebue
Escapement Report #39

Noatak River Salmon Studies, 1983

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

Appendix A

INTRODUCTION

Located immediately above the Arctic Circle, Kotzebue Sound supports the northern most commercial salmon fishery in Alaska (Figure 1). The numerous drainages in the region support all five species of Pacific salmon (Oncorhynchus sp.). However, chum salmon (O. keta) destined for the Noatak and Kobuk Rivers are the most abundant. Historic escapement data indicate that the Noatak River supports a chum salmon population roughly four to five times that of the Kobuk River (A.D.F.G. 1983). The Noatak River is the single greatest contributor of chum salmon to the commercial fishery in Kotzebue Sound.

Escapement Enumeration

Since the modern inception of the Kotzebue Sound commercial fishery in 1962, escapement assessments of the Noatak and Kobuk Rivers have been based primarily on aerial surveys. Gill net test fishing and hydroacoustic enumeration on the lower Noatak River (Cunningham 1976; Kuhlmann 1977; A.D.F.G. 1978, 1979; Bird 1980; Bird and Bigler 1982; Bigler 1983), and a counting tower on the Squirrel River, the principle chum salmon tributary of the Kobuk River (Dinnocenzo 1982), are recent examples of attempts to utilize different sources to obtain escapement information. Aerial survey techniques allow frequent and relatively inexpensive observations of escapement magnitude, but are considered minimum indices of escapement as conditions of weather, water, as well as the surveyor, play significant roles in the overall survey effectiveness.

Escapement enumeration through the operation of hydroacoustic equipment was first attempted on the Noatak River by Bird (Bird and Bigler 1982) and has been continued by the author (Bigler 1983). The primary objective of this work is to provide a tool for management of the Kotzebue Sound commercial fishery through a daily estimate of chum salmon escapement to the Noatak River.

Other objectives of work performed in 1983 were to:

1) Sample species, sex and age composition of Noatak River escapement using gill nets.
2) Determine run timing and magnitude of pink salmon (O. gorbuscha) and arctic char (Salvelinus alpinus) escapement.
3) Develop an annual index of chum salmon escapement based on test net Catch Per Unit Effort (CPUE).
4) Test the feasibility of using a recording fathometer to quantify midriver migrations of chum salmon.

Test Fishing

Gill nets have been operated on the lower Noatak River since 1975 to obtain an annual CPUE index of chum salmon escapement (Cunningham 1976; Kuhlmann 1977; A.D.F.G. 1978, 1 9/79; Bird 1980; A.D.F.G. 1982; Bird and Bigler 1982). Gill netting, using 5 7/8 inch stretched mesh nets, is conducted concurrently with sonar operations. An additional 4 inch mesh gill net, was operated for the first time in 1983. Combined results from both mesh sizes are used to apportion sonar counts to species.

Midriver Migration

During the 1982 season, a submerged gill net operated at midriver, captured significant numbers of chum salmon (Bigler 1983). These results suggested that chum salmon pass beyond the sonar operating range. Therefore, an additional objective for the 1983 season was to quantify or index the midriver passage using submerged gill nets and a recording fathometer.

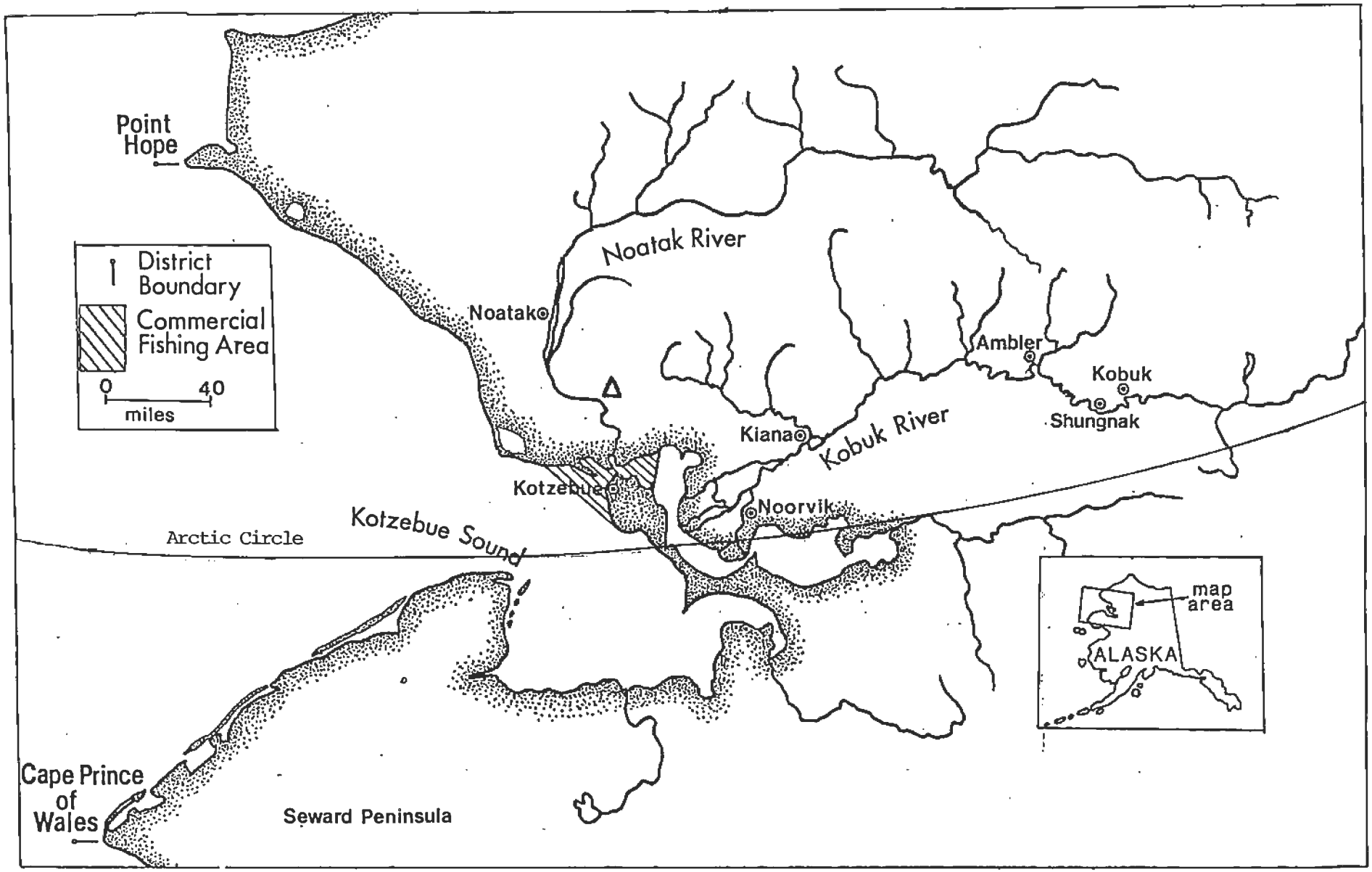

Figure 1. Kotzebue Sound commercial fishing district and site of Noatak River sonar project (Δ) 1983

METHODS

Sonar Enumeration

Two 1978 model, Bendix side scanning sonar counters and associated gear were installed on July 7, 1984, one on each bank within 100 yards of each other. Equipment was deployed in accordance with the accompanying manual: Installation and Operation Manual-Side Scan Sonar Counter-1978 model.

Once the sonar equipment was deployed and operating (July 4), a daily schedule of calibration and test fishing was maintained until the project terminated (September 7). Daily activity started at 0830 when test nets were deployed and the first of three daily calibration counts occurred (0830, 1430 and 2030).

Calibration consisted of observing echoes displayed on a Tektronix 323 oscilloscope connected to the sonar receiver. Observation periods were of 30 minutes duration. For the first 20 minutes, the sonar was operated at the normal 60 foot (18.3 m) range. During the remaining 10 minutes, the sonar beam was extended to 100 feet (30.5 m) to enumerate fish passing beyond the normal operating range.

Total daily sonar counts were adjusted by the expression:

$$A \times \frac{B_i}{C_i} \times \frac{(D_i+E_i)}{D_i} = \text{Adjusted Daily Count}$$

where; A = total daily sonar counts, B_i = observed oscilloscope counts during calibration period $_i$, C_i = sonar counts during calibration period $_i$, D_i = observed counts within 60 foot range for period $_i$ and, E_i = observed counts from 60 to 100 feet during period $_i$.

Adjustments were made in the Fish Velocity Control setting if the difference between oscilloscope and sonar counts exceeded 15 percent.

Test Fishing

Two multifilament test gill nets (Appendix A Table 1) were operated daily on alternate sides of the river and immediately upstream of each sonar (Figure 2). These gill nets provided information for species apportionment and allowed for the collection of chum salmon age, sex and size data. One net was of 5 7/8 inch (156 mm) stretched mesh which selects fish of average chum salmon size. The remaining 4 inch (102 mm) mesh gill net captured pink salmon, arctic char and other resident species of sufficient size to register counts on the sonar equipment. Nets were rotated from bank to bank on a 24 hour basis. Percentages of all species captured were applied to the adjusted daily sonar count and communicated to the Kotzebue office at the morning radio schedule (0800).

A 5 7/8 inch mesh gill net was fished daily from 8 July to 8 August on the bottom of the river beyond the 100 foot extended sonar beam. This net was fished to compare sonar related test net catches with those of a midriver net, and to index midriver chum salmon passage.

Figure 2. Aerial photo of Noatak River sonar project, 1983. Test nets and sonar lengths are drawn to scale, location of midriver migration sample sites [X] are approximate.

Chum Salmon Age, Sex and Size

All chum salmon captured were measured for length (mideye-fork), examined for sex, and a scale removed (from the preferred scale area) for age determination. Sex was determined by either internal examination of gonads for dead fish, or external morphology on live fish. External characteristics include snout, vent, body symmetry, and occasional appearance of milt or eggs. The adipose fin was removed from each sampled fish to avoid duplication if the fish was recaptured. Scales were mounted on gum cards and impressions made in cellulose acetate.

Midriver Migration

From 29 June through 5 August, a Lowerance "X-15" straight line recording fathometer was operated at seven sample sites, 75 feet apart, along a transect perpendicular to river flow (Figure 2). The fathometer was operated for 30 minute periods, four times a day (0800, 1200, 1600, 2000). The schedule of site sampling was determined by random selection without replacement for two days at a time. That is, four periods a day allowed sampling of all stations at least once every two days. Site number eight was eliminated from consideration due to shallow water.

Repetitive placement of the fathometer at each sample site was accomplished using a rope with four loops tied at 75 foot intervals. One end of the rope was anchored to shore, the appropriate loop was attached to the bow cleat and the boat was backed away from shore. When the site was reached (the end of the rope) an anchor was deployed and the shore-line detached. This technique allowed the consistent placement of the boat at sites along the transect. The boat was then held in an upstream attitude by the deployment of two sea anchors from the stern. Once in position the fathometer transducer, which was hinge-mounted, was rotated over the side and aimed perpendicular to the river surface at a depth of six inches. A technician then monitored the fathometer for the allotted period. Sensitivity and paper speed settings were kept constant throughout the season.

RESULTS AND DISCUSSION

Sonar Enumeration

Since 1975, an annual CPUE index of chum salmon escapement to the Noatak River has been calculated from the numbers of fish caught in 5 7/8 inch mesh gill nets. The operation of this single net size continued following the introduction of sonar equipment in 1979, when gill net catches were also used to apportion sonar counts to species. An underlying assumption to the use of only one net size is that few, if any, fish captured in other net sizes will be counted by the sonar equipment. The manufacturer has suggested that any fish larger than 300 mm passing through the center of the sonar beam (the acoustic axis) could register counts (Al Menin/Bendix Corporation, personal communication).

The use of a 4 1/2 inch mesh net in 1982 provided evidence that many sonar counts were attributable to pink salmon and arctic char (Bigler 1983). A 4 inch mesh net was operated in 1983 since few female pink salmon or whitefish (the predominant resident species), were captured in 1982. The capture of pink salmon, whitefish and arctic char, demonstrated that the majority of sonar counts prior to August 1 were actually species other than chum salmon (Table 1, Figure 3). These findings are consistent with those of two separate mark and recapture experiments which demonstrated that Noatak River chum salmon abundance does not peak in the Kotzebue Sound commercial fishery until early August (Yanagawa 1968; Dinnocenzo 1981; Bigler and Burwen 1982).

Table 1. Noatak River side scan sonar counts by species, 1983.

Date	Daily Adjusted Sonar Count	Chum Salmon			Pink Salmon			Arctic Char			Other Sp		
		Test Net Proportion	Daily Count	Cumulative Count	Test Net Proportion	Daily Count	Cumulative Count	Test Net Proportion	Daily Count	Cumulative Count	Test Net Proportion	Daily Count	Cumulati Count
July													
8	2032	0.07	142	142	0	0	0	0.21	427	427	0.71	1443	1443
9	1714	0.08	137	279	0	0	0	0.24	411	838	0.68	1166	2609
10	2500	0.13	325	604	0	0	0	0.25	625	1463	0.63	1575	4184
11	3643	0.13	474	1078	0	0	0	0.20	729	2192	0.67	2441	6625
12	3553	0.06	213	1291	0	0	0	0.25	888	3080	0.67	2452	9077
13	1389	0.06	83	1374	0.06	83	83	0.24	333	3413	0.65	903	9980
14	1794	0.09	161	1536	0.09	161	244	0.17	305	3718	0.65	1166	11146
15	1687	0.04	61	1597	0.11	181	425	0.11	181	3899	0.75	1265	12411
16	2219	0.06	140	1736	0.06	140	565	0.09	209	4107	0.78	1735	14146
17	3089	0.19	575	2311	0.16	504	1068	0.09	287	4395	0.56	1724	15870
18	2536	0.16	406	2717	0.26	659	1728	0.11	279	4674	0.47	1192	17062
19	1939	0	0	2717	0.17	324	2052	0.01	20	4694	0.73	1421	018483
20	2501	0	0	2717	0.21	515	2567	0.06	150	4844	0.74	1851	20334
21	2217	0	0	2717	0.29	643	3210	0.10	215	5059	0.61	1352	21686
22	2601	0.05	130	2847	0.27	702	3912	0.14	364	5423	0.54	1405	23091
23	1719	0.12	203	3051	0.29	505	4417	0.06	101	5524	0.53	909	24000
24	2649	0.14	379	3430	0.33	882	5299	0.05	127	5651	0.48	1264	25264
25	2963	0.11	326	3755	0.35	1037	6336	0.11	326	5977	0.43	1274	26538
26	1024	0.13	128	3883	0.38	384	6720	0.13	128	6105	0.38	384	26922
27	1399	0.16	224	4107	0.35	490	7210	0.10	136	6241	0.39	546	27468
28	2406	0.10	248	4355	0.23	556	7766	0.08	185	6426	0.59	1420	28888
29	2638	0.11	290	4645	0.11	290	8056	0.06	158	6584	0.72	1899	30787
30(3)	1730	0.15	260	4905	0.15	260	8316	0.06	104	6688	0.64	1107	31894
31	1285	0.19	244	5149	0.11	141	8457	0.11	141	6829	0.58	745	32639
August													
1	1627	0.21	342	5491	0.12	195	8652	0.15	244	7073	0.52	846	33485
2	1329	0.27	359	5850	0.24	318	8970	0.14	186	7259	0.35	465	33950
3	1658	0.28	464	6314	0.28	464	9434	0.08	133	7392	0.36	597	[illegible]
4(4)	1713	0.17	286	6600	0.44	754	10188	0.11	188	7580	0.28	478	[illegible]
5	1406	0.31	436	7036	0.47	661	10849	0.13	183	7763	0.09	127	[illegible]
6	1404	0.41	576	7612	0.34	477	11326	0.13	183	7946	0.13	183	[illegible]
7	993	0.41	407	8019	0.34	338	11664	0.13	129	8075	0.13	129	35462
8	1159	0.47	545	8564	0.16	185	11849	0.11	127	8202	0.26	301	35763
9(5)	1500	0.47	705	9269	0.16	240	12089	0.11	165	8367	0.26	390	36153
10(2)	1256	0.47	590	9859	0.16	201	12290	0.11	138	8505	0.26	327	36480
11(2)	1721	0.47	809	10668	0.16	275	12565	0.11	189	8694	0.26	447	36927
12	2873	0.88	2528	13196	0	0	12565	0	0	8694	0.12	345	37272
13	2364	0.44	1040	14236	0.11	260	12825	0.11	260	8954	0.33	780	38052
14	1760	0.44	774	15010	0.11	194	13019	0.11	194	9148	0.33	581	38633
15	1449	0.23	333	15343	0.13	449	13468	0.08	116	9264	0.38	551	39184
16	1214	0.11	134	15477	0.27	328	13796	0.05	61	9325	0.55	668	39852
17	2010	0.29	583	16060	0.24	482	14278	0.10	201	9526	0.38	764	40616
18	1957	0.44	861	16921	0.11	215	14493	0.22	431	9957	0.22	431	41047
19	2476	0.52	1287	18208	0.04	99	14592	0.35	867	10824	0.09	223	41270
20	1597	0.54	862	19070	0.02	32	14623	0.39	623	11447	0.04	64	41334
21	992	0.44	436	19506	0	0	14623	0.52	516	11963	0.04	40	41374
22	506	0.45	228	19734	0.03	15	14638	0.42	213	12176	0.10	51	41425
23	786	0.50	393	20127	0	0	14638	0.41	322	12498	0.09	71	41496
24	867	0.50	433	20560	0	0	14638	0.41	355	12853	0.09	78	41574
25	605	0.37	224	20784	0	0	14638	0.47	284	13137	0.16	97	41671
26	771	0.40	308	21092	0	0	14638	0.30	231	13368	0.30	231	41902
27	769	0.43	331	21423	0	0	14638	0.48	369	13737	0.09	69	41971
28	954	0.22	210	21633	0.02	19	14657	0.73	696	14433	0.02	19	41990
29	928	0.22	204	21837	0.03	28	14685	0.69	640	15073	0.06	56	42046
30	1113	0.44	490	22327	0	0	14685	0.48	534	15607	0.07	78	42124
Totals	94,743			22327			14685			15607			42124

(1) In order of seasonal abundance: Whitefish, Longnosed Suckers, Sheefish.
(2) Test net percents carried through from 8/8/83. No fishing due to high water and debris.
(3) Pink salmon migration midpoint.
(4) Arctic charr migration midpoint.
(5) Chum salmon migration midpoint.

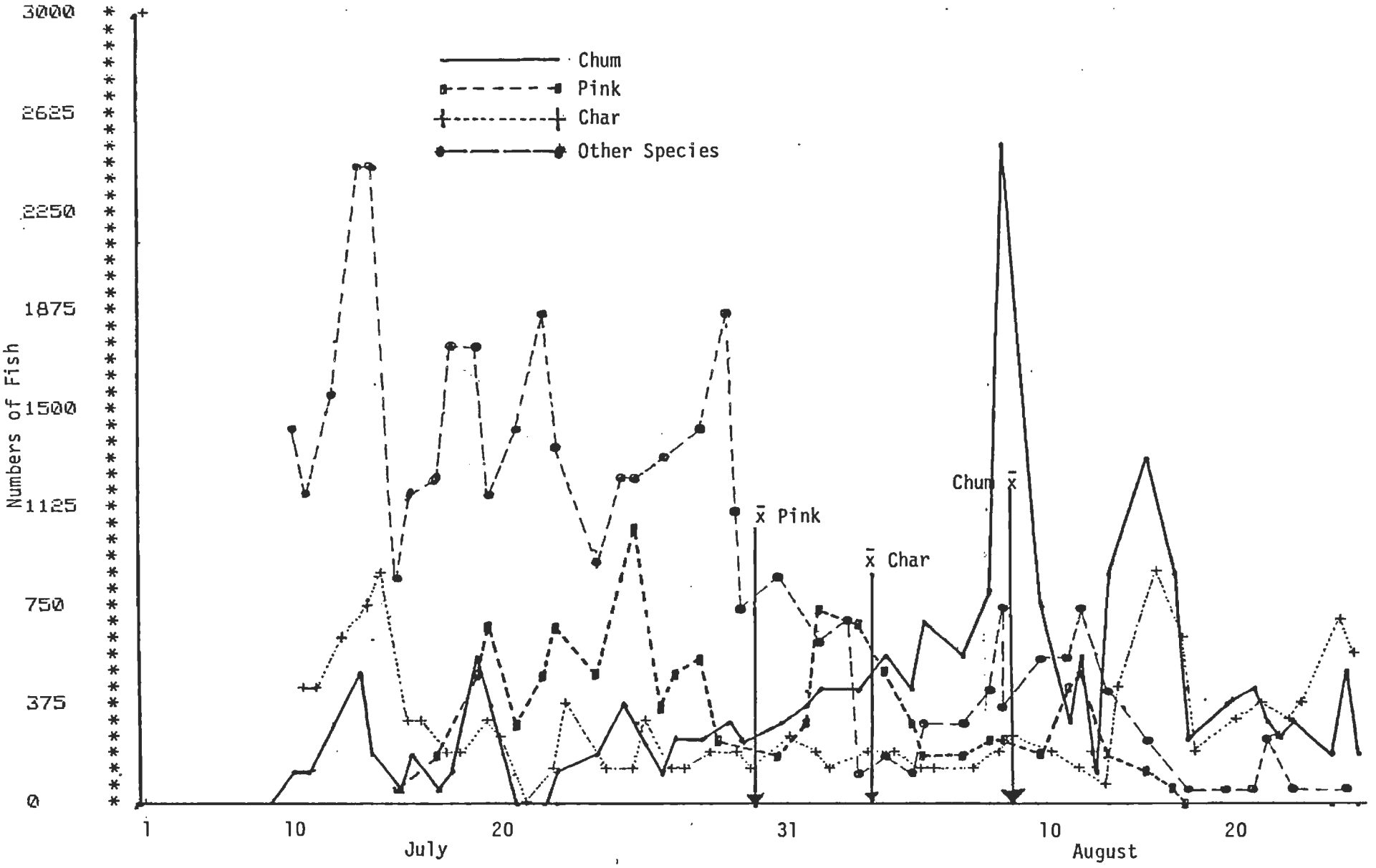

Figure 3. Numbers of chum and pink salmon, arctic char and other species (whitefish, sheefish and longnosed suckers) counted daily by side scan sonar, Noatak River, 1983. Midpoint of species migration denoted "$\bar{x}$".

From 5 July through 30 August, 22,327 chum salmon, 14,685 pink salmon, 15,607 arctic char and 42,124 other species of resident fish was counted by side scan sonar. Midpoints (Mundy 1982) of chum and pink salmon and arctic char migrations were 9 August, 30 July and 4 August, respectively (Table 1, Figure 3).

Spatial distribution of fish counts over the operating sonar range of each counter was roughly similar. The highest percentage of counts occurred in sector 10 (Figure 4) in both counters. The dissimilar diel distribution found in previous seasons was apparent in 1983. The rate of fish passage over the south bank sonar showed a slight tendency for hours of peak daylight (1100-1200) (Figure 5). Passage rate at the north bank sonar increased only slightly during reduced light periods (0200-0500) (Figure 5).

Test Fishing

Test nets (combined 5 7/8 and 4 inch mesh) were fished a total of 1,708.8 hours and captured 316 chum salmon, 223 pink salmon, 295 arctic char and 581 other species. The seasonal CPUE indices were 0.18, 0.13, 0.17, and 0.34, for each species, respectively (Table 2).

The number of chum salmon sampled from all sources (sonar plus midriver nets) for age, sex and size information totaled 468 fish (Table 3). Bernard (1982) recommended that a minimum sample size of 450, collected over any defined period of time was required to achieve specified levels of precision and accuracy in chum salmon age, sex or size composition data.

Midriver nets were intentionally operated beyond the operating range of the sonar equipment. No consistent catch or CPUE pattern is apparent between gill nets operated at the shoreline versus those operated at midriver. However, there are several instances where data collected from the two net cites are similar or where chum salmon catches at midriver exceed those of sonar-related nets (Table 4). The midriver net was operated daily from July 13 through August 8 when high water conditions and personnel constraints precluded further netting. The midriver net (5 7/8 inch mesh) was fished a total 181.9 hours and captured 78 chum salmon, resulting in a CPUE of 0.43. In comparison, the 5 7/8 inch mesh sonar net fished a total 491.0 hours during the same period and captured a 120 chum salmon for a CPUE of 0.24 or approximately half that of the midriver net (Table 4). These data suggest that chum salmon migrate at midriver in numbers greater than those counted by sonar.

Midriver Migration

Interpretation of the paper trace produced by the Lowrance fathometer proved to be highly subjective. Different interpretations resulted when several people were asked to analyze the same paper trace. High numbers of echoes were produced within 12 feet of the surface; only relatively strong echoes were recorded at greater depths. Even small objects which passed through the fathometer beam (such as a tab from a soda can) recorded large traces (Figure 6). Near Field Effect, as described by Urick (1976), creates a dead range within 4 feet of the transducer under established sensitivity settings. (Sensitivity levels were reduced for sampling shallow water at sampling site [1].)

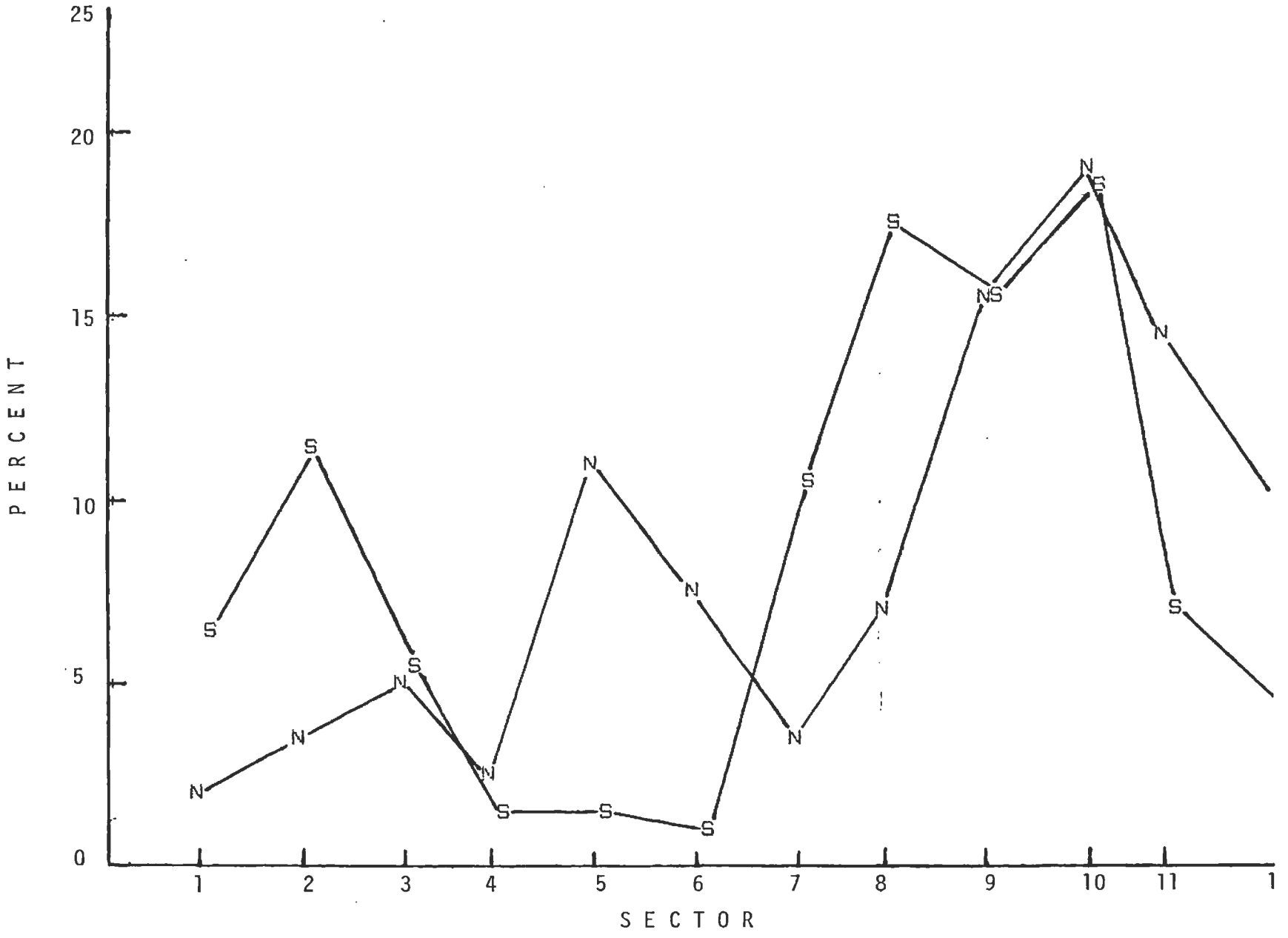

Figure 4. Sector distributions of fish counted by side scan sonar, Noatak River, 1983. Sector distance is 60 feet. North Bank (N); South Bank (S).

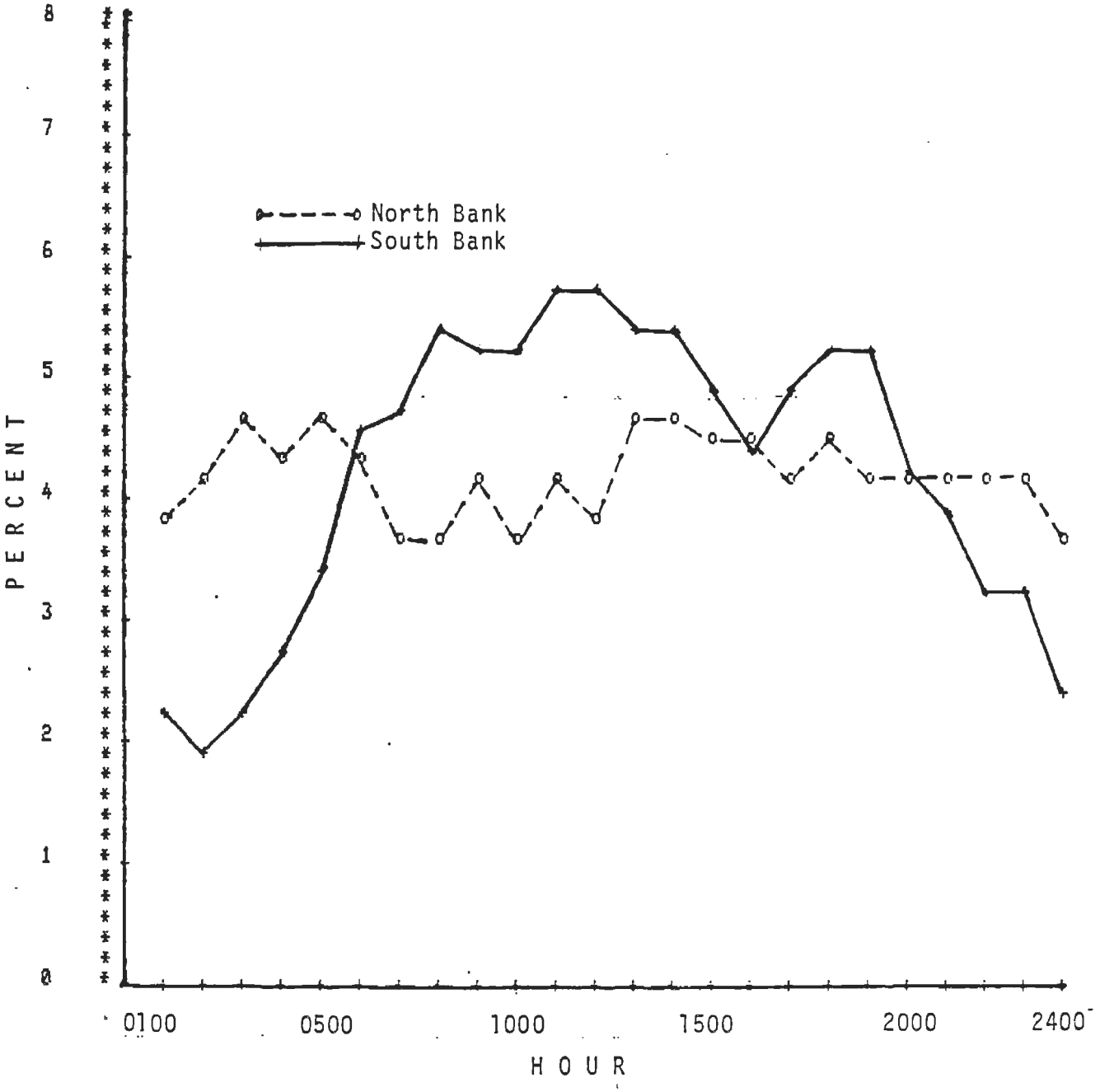

Figure 5. Hourly distributions of chum salmon counted by side scan sonar, Noatak River, 1983.

Table 2. Combined daily catch and CPUE from Noatak River test nets, 1983.

Date	Net Hours(1)	Daily Catch Chum	Pink	Char	Other	C.P.U.E. (2) Chum	Pink	Char	Other
June									
29	18.0	0	0	5	1	0	0	0.28	0.06
30	21.0	0	0	3	13	0	0	0.14	0.62
July	NF								
1	19.6	0	0	2	11	0	0	0.10	0.56
2	19.0	0	0	1	10	0	0	0.05	0.53
3	26.6	0	0	5	11	0	0	0.19	0.41
4	NF								
5	20.0	0	0	1	10	0	0	0.05	0.50
6	21.0	0	0	0	5	0	0	0	0.24
7	21.0	0	0	3	7	0	0	0.14	0.33
8	20.6	1	0	3	12	0.05	0	0.15	0.58
9	48.0	2	0	8	22	0.04	0	0.17	0.46
10	48.0	3	0	3	7	0.06	0	0.06	0.15
11	48.0	1	0	3	13	0.02	0	0.06	0.27
12	48.0	0	0	4	10	0	0	0.08	0.21
13	48.0	2	2	4	12	0.04	0.04	0.08	0.25
14	48.0	1	1	4	17	0.02	0.02	0.08	0.35
15	48.0	0	4	2	24	0	0.08	0.04	0.50
16	48.0	4	1	2	26	0.08	0.02	0.04	0.54
17	48.0	11	13	5	21	0.23	0.27	0.10	0.44
18	48.0	0	6	3	16	0	0.13	0.06	0.33
19	48.0	0	5	2	22	0	0.10	0.04	0.46
20	48.0	0	9	1	23	0	0.19	0.02	0.48
21	48.0	0	9	5	14	0	0.19	0.10	0.29
22	48.0	2	3	1	10	0.04	0.06	0.02	0.21
23	48.0	1	6	0	8	0.02	0.13	0	0.17
24	48.0	5	13	1	12	0.10	0.27	0.02	0.25
25	48.0	3	21	7	20	0.06	0.44	0.15	0.42
26	48.0	6	10	3	10	0.13	0.21	0.06	0.21
27	48.0	3	16	3	15	0.06	0.33	0.06	0.31
28	48.0	5	5	3	31	0.10	0.10	0.06	0.65
29	24.8	3	3	1	21	0.12	0.12	0.04	0.85
30	24.2	8	7	2	20	0.33	0.29	0.08	0.83
31	24.0	6	3	5	21	0.25	0.13	0.21	0.88

Table 2. Combined daily catch and CPUE from Noatak River test nets, 1983. (Continued)

Date	Net Hours(1)	Daily Catch Chum	Pink	Char	Other	C.P.U.E. (2) Chum	Pink	Char	Other
August									
1	24.0	8	9	5	12	0.33	0.38	0.21	0.50
2	24.0	11	11	4	14	0.46	0.46	0.17	0.58
3	18.0	2	2	0	4	0.11	0.11	0	0.22
4	25.0	3	13	3	5	0.12	0.52	0.12	0.20
5	22.0	16	17	4	0	0.73	0.77	0.18	0
6	23.0	9	6	3	7	0.39	0.26	0.13	0.30
7	NF								
8	5.0	12	0	0	2	2.40	0	0	0.40
9	NF								
10	NF								
11	NF								
12	NF								
13	20.0	7	1	1	5	0.35	0.05	0.05	0.25
14	20.0	5	0	0	0	0.25	0	0	0
15	23.0	1	8	1	9	0.04	0.35	0.04	0.39
16	22.0	3	5	0	10	0.14	0.23	0	0.45
17	18.0	8	7	4	6	0.44	0.39	0.22	0.33
18	20.0	12	1	8	7	0.60	0.05	0.40	0.35
19	23.0	32	3	24	1	1.39	0.13	1.04	0.04
20	19.0	17	0	11	3	0.89	0	0.58	0.16
21	19.0	8	0	15	0	0.42	0	0.79	0
22	15.5	24	1	11	6	1.60	0.07	0.73	0.40
23	21.0	10	0	14	1	0.48	0	0.67	0.05
24	NF								
25	21.0	7	0	4	4	0.33	0	0.19	0.19
26	20.0	6	0	3	3	0.30	0	0.15	0.15
27	23.0	16	0	19	2	0.70	0	0.83	0.09
28	22.0	8	1	40	0	0.36	0.05	1.82	0
29	19.0	17	1	11	4	0.89	0.05	0.58	0.21
30	23.0	12	0	15	1	0.52	0	0.65	0.04
Total	1,708.8	316	223	295	581	0.18	0.13	0.17	0.34

(1) Combined fishing time of two test gill nets, 5 7/8 inch and 4 inch stretched mesh. NF=Not Fished, due to high water and debris.
(2) Catch per net-hour.

Table 3. Age, sex and size data collected from chum salmon captured in test gill nets, Noatak River, 1983.

	Age Class(1)				
	31	41	51	61	Total
Males					
Percent	4.70	16.67	9.62	0.43	31.41
Mean Length	551.0	607.3	638.2	625.0	608.6
S.D.	34.8	36.8	44.4	48.1	38.3
Sample Size	22	78	45	2	147
Females					
Percent	4.70	42.31	19.87	1.71	68.59
Mean Length	561.4	591.7	614.0	620.3	596.8
S.D.	22.5	26.7	28.2	27.8	26.9
Sample Size	22	198	93	8	321
Total					
Percent	9.40	58.97	29.49	2.14	100.00
Mean Length	556.2	596.1	621.9	621.2	600.5
S.D.	28.7	29.6	33.5	31.9	30.5
Sample Size	44	276	138	10	468

(1) Gilbert-Rich formula: the first digit refers to the total age, the second digit, normally subscripted, refers to the freshwater age, leaving the difference between the two the marine age.

Table 4. Total daily chum catch and CPUE for 5 7/8 inch mesh test nets. Surface net is associated with sonar species allocation. Submerged net is midriver test net. Noatak River, 1983.

Date	Net Hours(1) Surface	Net Hours(1) Submerged	Daily Chum Catch Surface	Daily Chum Catch Cum.	Daily Chum Catch Submerged	Daily Chum Catch Cum.	C.P.U.E. Surface	C.P.U.E. Submerged
July								
5	10.0	NF	0	0	0	0	0	0
6	10.5	NF	0	0	0	0	0	0
7	10.5	NF	0	0	0	0	0	0
8	10.3	NF	1	1	0	0	0.10	0
9	24.0	NF	2	3	0	0	0.08	0
10	24.0	NF	3	6	0	0	0.13	0
11	24.0	NF	1	7	0	0	0.04	0
12	24.0	NF	0	7	0	0	0	0
13	24.0	8.0	2	9	7	7	0.08	0.88
14	24.0	6.5	1	10	2	9	0.04	0.31
15	24.0	6.5	0	10	11	20	0	1.69
16	24.0	7.3	4	14	1	21	0.17	0.14
17	24.0	6.5	11	25	3	24	0.46	0.46
18	24.0	7.0	0	25	0	24	0	0
19	24.0	7.0	0	25	0	24	0	0
20	24.0	7.5	0	25	0	24	0	0
21	24.0	9.0	0	25	2	26	0	0.22
22	24.0	8.0	2	27	5	31	0.08	0.63
23	24.0	9.0	1	28	1	32	0.04	0.11
24	24.0	11.0	5	33	8	40	0.21	0.73
25	24.0	9.5	3	36	4	44	0.13	0.42
26	24.0	4.5	6	42	2	46	0.25	0.44
27	24.0	8.0	3	45	6	52	0.13	0.75
28	24.0	9.0	5	50	2	54	0.21	0.22
29	24.0	8.5	3	53	6	60	0.24	0.71
30	12.0	5.5	7	60	4	64	0.58	0.73
31	13.0	8.3	6	66	1	65	0.46	0.12

Table 4. Total daily chum catch and CPUE for 5 7/8 inch mesh test nets. Surface net is associated with sonar species allocation. Submerged net is midriver test net, Noatak River, 1983.

Date	Net Hours(1) Surface	Submerged	Daily Chum Catch Surface	Cum.	Submerged	Cum.	C.P.U.E. Surface	Submerged
August								
1	12.0	6.5	8	74	6	71	0.67	0.92
2	12.0	6.4	11	85	3	74	0.92	0.47
3	9.0	6.3	2	87	0	74	0.22	0
4	NF	NF						
5	11.0	5.8	16	103	1	75	1.45	0.17
6	11.5	7.0	9	112	0	75	0.78	0
7	NF	NF						
8	2.5	3.3	8	120	3	78	3.20	0.91
9	NF	NF						
10	NF	NF						
11	NF	NF						
12	NF	NF						
13	10.0	NF	2	122	0	78	0.20	0
14	10.0	NF	5	127	0	78	0.50	0
15	11.5	NF	1	128	0	78	0.09	0
16	11.0	NF	3	131	0	78	0.27	0
17	9.0	NF	8	139	0	78	0.89	0
18	10.0	NF	0	139	0	78	0	0
19	11.5	NF	32	171	0	78	2.78	0
20	9.5	NF	17	188	0	78	1.79	0
21	9.5	NF	6	194	0	78	0.63	0
22	7.5	NF	22	216	0	78	2.93	0
23	10.5	NF	10	226	0	78	0.95	0
24	NF	NF						
25	10.5	NF	4	230	0	78	0.38	0
26	10.0	NF	5	235	0	78	0.50	0
27	11.5	NF	14	249	0	78	1.22	0
28	11.0	NF	4	253	0	78	0.36	0
29	9.5	NF	11	264	0	78	1.16	0
30	11.5	NF	12	276	0	78	1.04	0
Total	802.3	181.9		276		78	0.34	0.43
Total(2)	491.0	181.9		120		78	0.24	0.43

(1) NF=Not Fished, due to high water and debris.
(2) Only total hours fished and chum salmon captured during the period both nets operated.

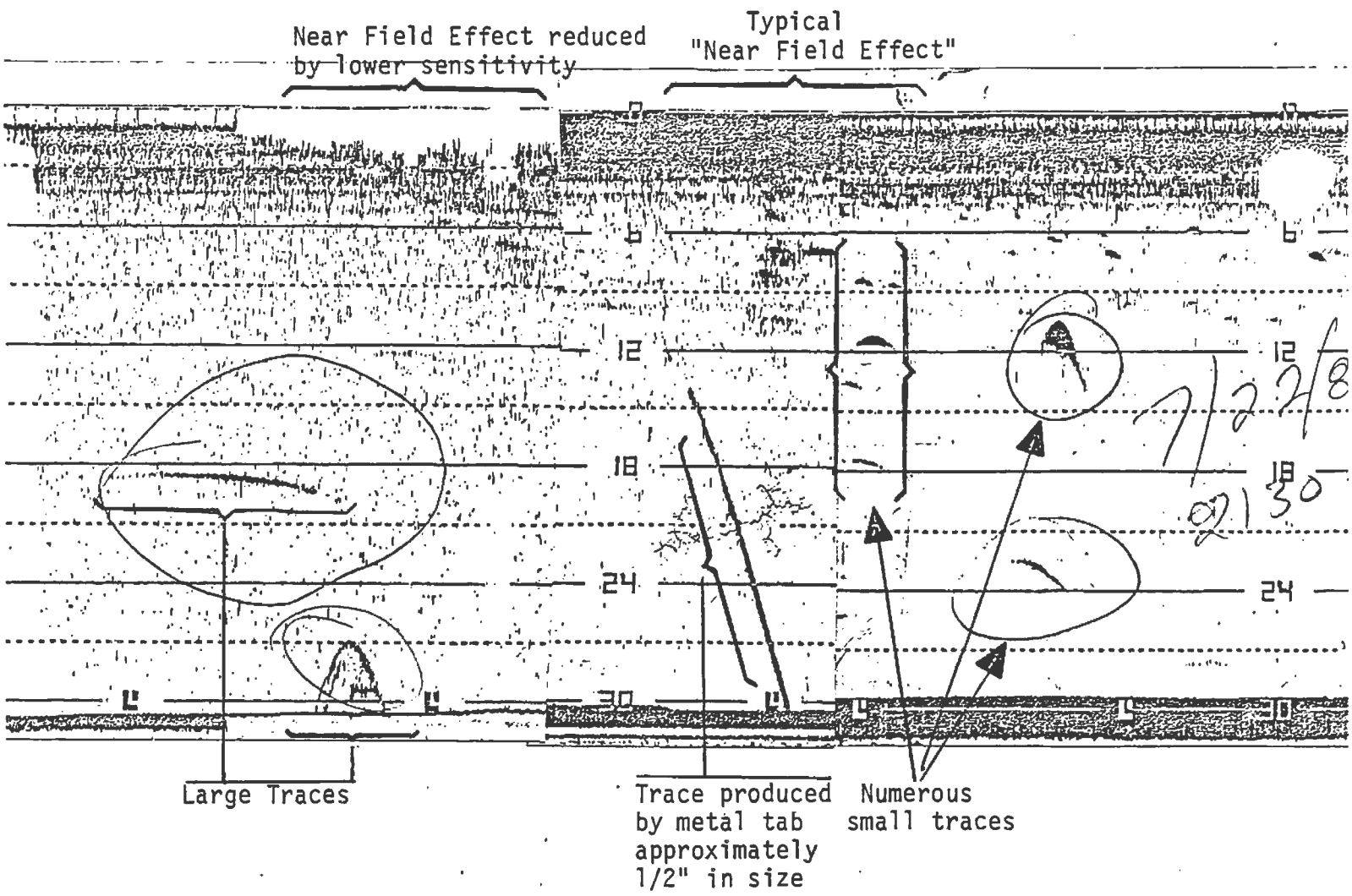

Figure 6 Typical paper trace produced by Lowarance "X-15" Fathometer, Noatak River, 1983. This figure is a composit to demonstrate the variety of traces produced by objects passing through the sonar beam. Trace of metal tab was made by dropping the tab into the water immediately upstream from the transducer.

Because the interpretation of fathometer results was highly subjective and few targets were registered which could be considered with certainty, chum salmon, an accurate estimate of fish passage based on this equipment is not possible. Therefore, the project was terminated prematurely.

SUMMARY AND CONCLUSIONS

Escapement assessments taken by sonar counters over the past four years on the Noatak River, which heretofore have been considered total escapement estimates, are now considered highly suspect for the following reasons:

1) The area ensonified by the Bendix sonar equipment is a minimal subsample of the total water column.
2) Test netting performed concurrently with sonar counters indicates that the majority of fish meeting the minimum criteria for counting by side scan sonar, in 1982 and 1983 were species other than chum salmon.
3) Comparison of the total Noatak River chum salmon escapement based on sonar counts (22,327) and the results of aerial escapement surveys (94,954) indicate that sonar estimates account for only a fraction of total escapement.
4) Test net CPUE data indicate that the unaccounted for component of chum salmon escapement passes beyond the operating range of the presently used sonar equipment.

In conclusion, evidence provided in 1982 and 1983 indicate that the Bendix side scan sonar equipment is unsuitable for estimating total chum salmon escapement in the Noatak River.

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Appendix A Table 1. Specifications for Noatak River test fishing gill nets, 1983.

Filament Type	Twine Size	Stretched Mesh Size	Webbing Length	Mesh Depth	Leadline Type	Floatline Type	Floats	Hanging Ratio	Comments
Nylon Multi-filament	#73	5 7/8"	150' 25 Fath.	28	Braided, Leadcore 100#/100Fath.	Braided, Filament Core-1/2"	K-9, Soongex, every 5th hanging	2:1	Dyed Green, Hung to Float
Nylon Multi-filament	#73	4"	150' 25 Fath.	35	Braided, Leadcore, 100/100Fath.	Braided, Filament Core-1/2"	K-9, Soongex, every 5th hanging	2:1	Hung to Float